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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/768,515	01/30/2004	Bhanwar Singh	AMDP999US/H1920	6654

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EXAMINER

RUGGLES, JOHN S

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 08/08/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/768,515

Applicant(s)

SINGH ET AL.

Examiner

John Ruggles

Art Unit

1756

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 June 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) 9-23 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 January 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

Objection to Reply

In response to the reply filed on 6/2/06, it is noted at the outset that Applicants have **incorrectly** identified this application with the *wrong title*. While other identifying information for this application (serial number, filing date, and the name of the first inventor) appears to be correct, Applicants are now required to specifically acknowledge for the record that the title used in the 6/2/06 reply was incorrect and to specifically state the correct title for this application.

Election/Restrictions

Applicants' election of Group I (claims 1-8) with traverse in the reply filed on 6/2/06 is acknowledged. However, the election has been treated as an election **without** traverse, because Applicants did not distinctly and specifically point out the supposed errors in the restriction requirement (MPEP § 818.03(a)). Therefore, claims 9-23 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention.

Drawings

Figures 1-3 should each be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Art Unit: 1756

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: "882" at page 10 line 1 is not shown in Figure 8 (to which this passage refers). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

The abstract of the disclosure is objected to at least because it has more than 150 words. This objection can be overcome by shortening the instant abstract to correspond with only the instant mask of elected claims 1-8. Correction is required. See MPEP § 608.01(b).

Art Unit: 1756

35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms, which are not clear, concise and exact. The specification should be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some unclear, inexact or verbose terms used in the specification are: (1) at page 1 line 8, "small features in achievable in nanoprint lithography" should be corrected to --small features ~~[[in]]~~ achievable in nanoprint lithography--; (2) at page 1 line 26, "(the resist or lithographic coating)" should be changed to --~~[[the]]~~ a resist or a lithographic coating--; and (3) at page 1 lines 27-28, the phrase "the surface" should be amended to --the ~~surface~~ coated silicon structure--, in order to correspond with the antecedent basis for this phrase. Note that due to the number of errors, those listed here are merely *examples* of the corrections needed and do *not* represent an exhaustive list thereof.

Appropriate correction is required. An amendment filed making all appropriate corrections must be accompanied by a statement that the amendment contains no new matter and also by a brief description specifically pointing out which portion of the original specification provides support for each of these corrections.

Claim Rejections - 35 USC § 102/103

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

Art Unit: 1756

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by Glendinning (US 4,816,361).

Glendinning teaches masks for either optical or X-ray lithography, as well as methods of making them (title, abstract). Front page Figure 5 shows a (radiation) imprint mask including ridges or three dimensional (3D) features 21 having vertical sidewalls coated with opaque/absorbing material 51 (e.g., Cr, etc.) on either a transparent (translucent) glass or membrane substrate (c2/L50-65, c4/L44-59, *instant claim 1*).

Claims 2-3 are rejected under 35 U.S.C. 102(b) as being anticipated by Glendinning (US 4,816,361) in view of Grant et al. (Grant & Hackh's Chemical Dictionary, Fifth Edition, 1987).

While teaching a mask having 3D features with vertical sidewalls coated with absorbing material on a translucent glass substrate, Glendinning does not specifically teach that the glass substrate comprises silicon dioxide (SiO_2 , *instant claim 2*) or that the glass substrate is a quartz (*instant claim 3*). However, Grant et al. specifically define quartz as being silica or silicon dioxide (SiO_2 , page 487) and further define silica glass as having over 96% SiO_2 (page 261), so it is clear that the translucent glass substrate of Glendinning encompasses a silica glass substrate comprising SiO_2 (*instant claim 2*), such as a quartz (*instant claim 3*), within the accepted meanings of these terms.

Claims 1 and 3 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by either Vasudev et al. (WO 94/17450) or Vasudev et al. (US 5,411,824).

Art Unit: 1756

Vasudev et al. '450 teach a phase shifting mask (PSM) having trenches in a transparent or translucent quartz substrate (*instant claim 3*) to form shifters, in which the trenches have vertical sidewalls coated with an absorbing or attenuating film and methods of making this PSM (title, abstract). Exposure wavelengths include ultraviolet (UV), I-line (356nm), or deep UV (DUV, 248nm, p2/L20-34). Front page Figure 2A shows a PSM 30 having PS trenches 12 in a quartz or glass substrate 11 with intermediate non-PS (3D) features between the trenches 12 having vertical sidewalls 13, in which only the vertical sidewalls 13 are coated with absorbing/attenuating material 31 (that either fully or partially absorbs incident light radiation and has a thickness of "t", p8/L20-25, p9/L32 to p10/L7). The absorbing/attenuating material 31 is either metal (e.g., chromium (Cr), molybdenum (Mo), aluminum (Al), gold (Au), etc.), an alloy thereof, a silicide thereof, or silicon (Si) typically having a thickness (t) or skin depth that is in the range of 100-500 Angstroms (10-50nm), in which t for Si material is appropriately designed to be greater than that for metallic material in order to achieve the same absorbance level of incident light radiation (p12/L2-27, p13/L26-31, p18/L21-27, *instant claim 1*).

Vasudev et al. '824 teach a phase shifting mask (PSM) having trenches in a transparent or translucent quartz substrate (*instant claim 3*) to form shifters, in which the trenches have vertical sidewalls coated with an absorbing or attenuating film (title, abstract, c2/L53-58). Exposure wavelengths include ultraviolet (UV), I-line (356nm), or deep UV (DUV, 248nm, c1/L53 to c2/L8). Figure 2A shows a PSM 30 having PS trenches 12 in a quartz or glass substrate 11 with intermediate non-PS (3D) features between the trenches 12 having vertical sidewalls 13, in which only the vertical sidewalls 13 are coated with absorbing/attenuating material 31 (that either fully or partially absorbs incident light radiation and has a thickness of "t", c3/L36-41,

Art Unit: 1756

c4/L13-26). The absorbing/attenuating material 31 is either metal (e.g., chromium (Cr), molybdenum (Mo), aluminum (Al), gold (Au), etc.), an alloy thereof, a silicide thereof, or silicon (Si) typically having a thickness (t) or skin depth that is in the range of 100-500 Angstroms (10-50nm), in which t for Si material is appropriately designed to be greater than that for metallic material in order to achieve the same absorbance level of incident light radiation (c5/L20-43, c5/L63-68, *instant claim 1*).

Claim 2 is rejected under 35 U.S.C. 102(b) as being anticipated by either Vasudev et al. (WO 94/17450) or Vasudev et al. (US 5,411,824) in view of Grant et al. (Grant & Hackh's Chemical Dictionary, Fifth Edition, 1987).

While teaching a mask having 3D features with vertical sidewalls coated with absorbing material on a translucent quartz or glass substrate, neither Vasudev et al. '450 nor Vasudev et al. '824 specifically teach that the quartz or glass substrate comprises silicon dioxide (SiO₂, *instant claim 2*). However, it is clear from Grant et al. (as discussed above) that the translucent quartz or glass substrate for the PSM taught by either Vasudev et al. '450 or Vasudev et al. '824 encompasses a silica glass substrate comprising SiO₂ (*instant claim 2*), within the accepted meanings of these terms.

Claims 4 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Glendinning (US 4,816,361), Vasudev et al. (WO 94/17450), or Vasudev et al. (US 5,411,824) in view of Hashimoto (US 5,786,114).

While teaching other aspects of the instant claims, neither Glendinning, Vasudev et al. '450, nor Vasudev et al. '824 specifically teach that the mask or PSM has absorbing material comprising silicon oxynitride (SiON, *instant claim 4*) or titanium nitride (TiN, *instant claim 8*).

Art Unit: 1756

Hashimoto teaches a PSM having a patterned layer of attenuating or absorbing material 11 (e.g., SiON, TiN, SiN, SiN_x, SiO, etc.) with a transmissivity of 3% (absorbing 97% of incident UV exposure light, which is considered to be sufficiently opaque to ensure isolation of exposure light in frame or edge regions 19) on a suitable light transmissive or translucent substrate 13 (e.g., quartz, etc.), as shown in Figures 2A-2C (title, abstract, c4/L54-c5/L21). Thus, SiON and TiN have each been known as alternative absorbing materials for some time as having sufficiently high absorbance of UV exposure light to be considered as alternative opaque or absorbing materials with proven utility on a mask, such as a PSM.

It would have been obvious to one of ordinary skill in the art at the time of the invention in a mask having absorbing material deposited on vertical sidewalls of 3D features (as taught by either Glendinning, Vasudev et al. '450, or Vasudev et al. '824) to use either SiON or TiN for the absorbing material, because SiON and TiN have been known for some time as being alternative opaque or absorbing materials toward UV exposure light with proven utility on a mask (as taught by Hashimoto, *instant claims 4 and 8*).

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over either Glendinning (US 4,816,361), Vasudev et al. (WO 94/17450), or Vasudev et al. (US 5,411,824) in view of either Takemura (US 5,530,265) or French et al. (US 2006/0051974).

While teaching other aspects of the instant claim, neither Glendinning, Vasudev et al. '450, nor Vasudev et al. '824 specifically teach that the mask or PSM has absorbing material comprising silicon-rich (silicon) nitride (Si-rich SiN, *instant claim 5*).

Takemura teaches patterning through a patterned resist 107 of an underlying Si-rich SiN layer (106, preferably having a thickness of 50nm or more) that is known as an exemplary

Art Unit: 1756

"masking" (e.g., absorbing, etc.) material (for e.g., UV light, etc.), as shown in Figure 1(c) (c6/L18-25, *instant claim 5*).

French et al. teach a halftone mask (which is an attenuating or a partially absorbing PSM), a method of making this mask, and a method of using this mask (title, abstract, [0012]-[0014]). Figure 2(a) shows the exposure of a resist 10 through a halftone mask 12 having a UV-transparent or translucent mask substrate 14, a patterned layer of Si-rich SiN ($\text{SiN}_x\text{:H}$ with x in the range of 0 to 1) half-tone mask material 16 on the substrate and a Cr light blocking layer 18 over part of the Si-rich SiN half-tone mask material. In half-tone regions 24, only the half-tone mask material without Cr is present, where the transmission of UV light is in the range of 20% to 80% (absorbing 80% to 20% of incident UV exposure light [0023]). The use of Si-rich silicon (nitride, SiN) offers the further benefit that the precise properties of the Si-rich SiN layer 16 may be varied depending in particular on the wavelength of light emitted by the UV light source 30 [0033]. Figure 5 shows the effect of changing the optical band gap for a 60 nm thick layer of (Si-rich) SiN. The optical transmission is a strong function of the band gap. Accordingly, by controlling the band gap it is a relatively straight forward problem to accurately control the transmission or absorption through the (Si-rich) SiN mask layer 16, which is preferably manufactured to have a band gap in the range 2.15 eV to 2.35 eV to correspond to the wavelengths of widely used UV light sources 30, in particular the i-line, h-line or g-line of mercury lamps ([0036], *instant claim 5*).

It would have been obvious to one of ordinary skill in the art at the time of the invention in a mask having absorbing material deposited on vertical sidewalls of 3D features (as taught by either Glendinning, Vasudev et al. '450, or Vasudev et al. '824) to use Si-rich SiN for the

Art Unit: 1756

absorbing material with a reasonable expectation of forming a useful mask, because Si-rich SiN is a known alternative absorbing material for UV light (as taught by Takemura) that offers the further benefit of accurately variable transmission or absorbance of UV exposure light by controlling the band gap of the Si-rich SiN to correspond with the particular wavelength of the UV exposure light (as taught by French et al., *instant claim 5*).

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over either Glendinning (US 4,816,361), Vasudev et al. (WO 94/17450), or Vasudev et al. (US 5,411,824) in view of either Aggas et al. (US 5,944,157) or Aggas et al. (US 6,020,590).

While teaching other aspects of the instant claim, neither Glendinning, Vasudev et al. '450, nor Vasudev et al. '824 specifically teach that the mask or PSM has absorbing material comprising silicon-rich (silicon) oxide (Si-rich Si-O, *instant claim 6*).

Aggas et al. '157 teach that a layer of Si-rich Si-O blocks or absorbs 80% to 100% of incident UV light (e.g., Si-rich Si-O absorbs about 90% of i-rays at a wavelength of 365nm from an exposure stepper, etc.), while still being substantially transparent to visible light wavelengths. Such a Si-rich Si-O can be made to have a desired complex refractive index spectra from an appropriate ratio of Si to O during formation by either plasma enhanced chemical vapor deposition (PECVD) or sputtering (c7/L10-52).

Aggas et al. '590 teach that a layer of Si-rich Si-O blocks or absorbs 80% to 100% of incident UV light (e.g., Si-rich Si-O absorbs about 90% of i-rays at a wavelength of 365nm from an exposure stepper, etc.), while still being substantially transparent to visible light wavelengths. Such a Si-rich Si-O can be made to have a desired complex refractive index spectra from an

Art Unit: 1756

appropriate ratio of Si to O during formation by either plasma enhanced chemical vapor deposition (PECVD) or sputtering (c7/L10-52).

It would have been obvious to one of ordinary skill in the art at the time of the invention in a mask having absorbing material deposited on vertical sidewalls of 3D features (as taught by either Glendinning, Vasudev et al. '450, or Vasudev et al. '824) to use Si-rich Si-O for the absorbing material with a reasonable expectation of forming a useful mask, because Si-rich Si-O is a known alternative absorbing material for UV exposure light that offers the benefit of being made to have a desired absorbance of UV exposure light wavelengths while still being substantially transparent to visible light wavelengths by just varying the ratio of Si to O during formation of the Si-rich Si-O layer (as taught by either Aggas et al. '157 or Aggas et al. '590, *instant claim 6*).

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over either Glendinning (US 4,816,361), Vasudev et al. (WO 94/17450), or Vasudev et al. (US 5,411,824) in view of Yeh (US 2003/0193068).

While teaching other aspects of the instant claim, neither Glendinning, Vasudev et al. '450, nor Vasudev et al. '824 specifically teach that the mask or PSM has absorbing material comprising silicon oxycarbidenitride (SiOCN, *instant claim 7*).

Yeh teaches that a layer of SiONC or SiOCN is semi-transparent or partially absorbing for excimer laser wavelengths (which are understood to include UV light wavelengths, e.g., 157nm, 193nm, 248nm, etc.). Such a SiOCN layer (e.g., at a thickness of 800nm, etc.) can be formed by PECVD from tetramethylsilane, oxygen, and nitrogen as source materials to achieve a desired absorbing coefficient for a target UV light wavelength (so that a SiOCN layer of the

Art Unit: 1756

same thickness can have a widely variable absorbing coefficient, e.g., $12,000\text{ cm}^{-1}$, $4,000\text{ cm}^{-1}$, etc., [0009], [0035], [0041], presumably based on differing PECVD process conditions during formation of the SiOCN layer, *instant claim 7*).

It would have been obvious to one of ordinary skill in the art at the time of the invention in a mask having absorbing material deposited on vertical sidewalls of 3D features (as taught by either Glendinning, Vasudev et al. '450, or Vasudev et al. '824) to use SiOCN for the absorbing material with a reasonable expectation of forming a useful mask, because SiOCN is a known alternative absorbing material for UV light that offers the benefit of being made to have a desired absorbance of a target UV light wavelength by varying PECVD process conditions during formation of the SiOCN layer from tetramethylsilane, oxygen, and nitrogen source materials (as taught by Yeh, *instant claim 7*).

Conclusion

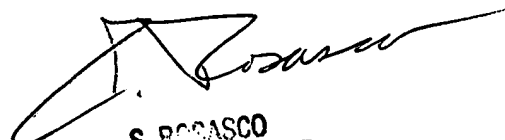
Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 1756

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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